AES-42 and digital microphones

Practical application of the SuperCMIT

Helmut Wittek, SCHOEPS GmbH

AES-42 and digital microphones

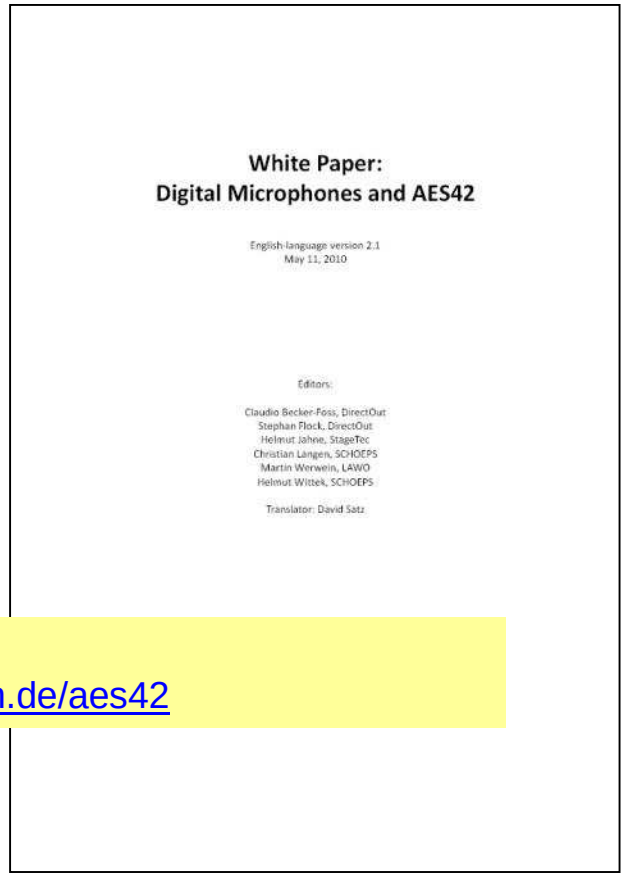
1. What is a digital microphone?
2. The dynamics of a microphone - A/D converter chain
3. What does the standard AES42 stand for?
4. Which practical issues arise with digital microphones?
5. Practical experience with digital microphones
6. Additional benefit of digital microphones?
7. Future of digital microphones

8. SuperCMIT: Technology, Hardware
9. SuperCMIT: Properties
    - Frequency responses, Polar patterns
    - Diffuse field response
10. SuperCMIT: Application and sound samples

White paper AES42

- White paper „Digital microphones and AES42“
  - joint paper from several authors and various companies
  - Aimed neutral, product-independent
  - available for download on www.hauptmikrofon.de/aes42
  - English and German version
  - current version 2.1 (September 2010)

- Authors:
  - Claudio Becker-Foss, DirectOut
  - Stephan Flock, DirectOut
  - Helmut Jahne, StageTec
  - Christian Langen, SCHOEPS
  - Martin Werwein, LAWO
  - Helmut Wittek, SCHOEPS


White Paper:
Digital Microphones and AES42

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Editors:

Claudio Becker-Foss, DirectOut
Stephan Flock, DirectOut
Helmut Jahne, StageTec
Christian Langen, SCHOEPS
Martin Werwein, LAWO
Helmut Wittek, SCHOEPS

Translator: David Satz

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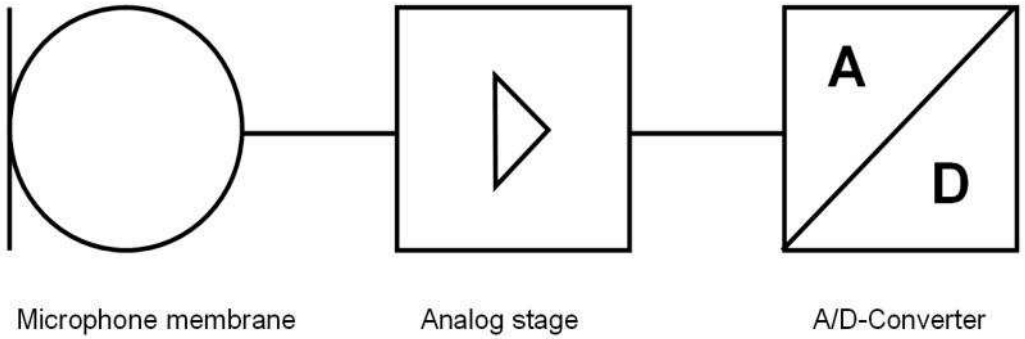
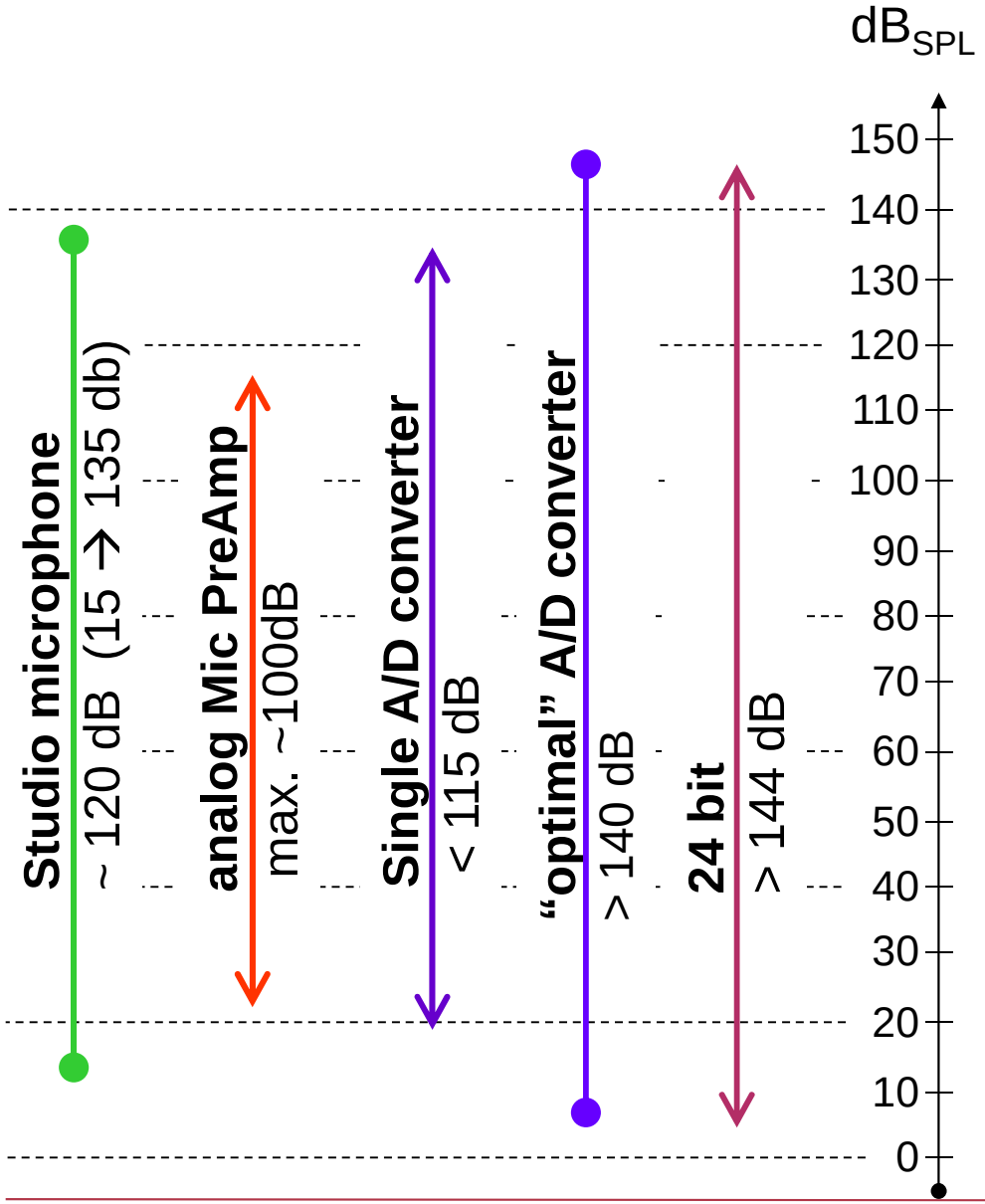
1. What is a digital microphone?



Schema of a contemporary “digitized“ microphone:
Membrane → analog gain stage → A/D converter

- What is different to the conventional signal chain: “analog microphone + preamp + A/D converter”?
- Other converter options for digital microphones?

2. The dynamics of a microphone



Postulation: $\Delta L > 120$ dB without audible "digital" noise:

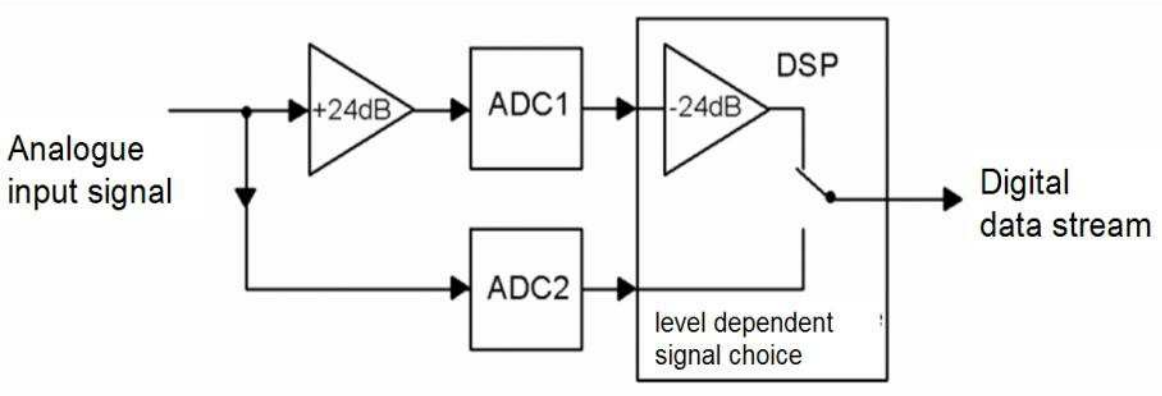
- Noise floor of the *capsule* should be the lower limit
- Max. SPL of the *capsule* should be the upper limit

- In terms of "practical" dynamics, analog microphones in an optimal signal chain can **not** be improved
- But: with a digital microphone, no more need for leveling the preamp and the A/D converter!

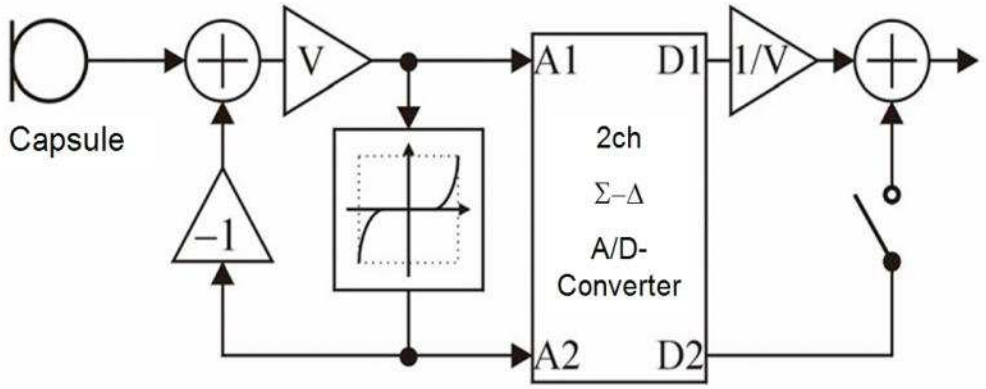
➢ Can digital microphones be better than analog microphones in terms of dynamics?

- Gain-Ranging principles

Classical Gain-Ranging:



„Neumann principle“:



➢ Is Gain ranging audible?

3. What does the standard AES42 stand for?

AES42 (mandatory):

- AES 3 Data Stream
- Digital Phantom Power (DPP): 10 V (Current max.250 mA)
- Synchronization after:
  - Mode 1: microphone runs on its own clock with fixed SR. *It is the master of the connected system or a SRC is used.*
  - Mode 2: microphone is synchronized by an external clock
- Remote Features:
  - Simple Command Set:
    - Pre-attenuation, Directional pattern, Low-Cut, Mute, Limiter, Gain, Mode 2
  - Extended Command Set:
    - Lights, test signals, reset, Dither/NS, SR, M/S-X/Y, Balance, Equalizer, phase, Compressor/Limiter settings,
    - in discussion: data storage
- Microphone Identification, etc.

- ➢ Which features are/will be implemented in existing equipment?
- ➢ Are all AES42-compliant devices “compatible”?

4. Practical issues with digital microphones

Existing AES42 Microphones:

- Neumann D-01, KMD series
- Neumann TLM 103D, KMR 81/82D, KMS 104D
- SCHOEPS CMD 2 with full Colette series
- SCHOEPS SuperCMIT
- Sennheiser MZD 8000

- Which interface do I need?
- Is a „first step“ solution sufficient for me?

Existing AES42-Interfaces:

- I/O Systems and mixing consoles (StageTec Nexus card)
- 19“-Equipment (RME DMC 842)
- D/A boxes (Lake People DAC C462)
- Manufacturers‘ solutions (Neumann DMI series)
- PC interface cards (Marian Trace ASE42-4)
- Portable recorders (Sound Devices 788 T, AETA 4MinX)
- *First step* and works with AES3 interfaces: Simple AES42 powering boxes (SCHOEPS PSD 2U, Neumann starter kit)

4. Practical issues with digital microphones

Latency

- each microphone model has a different latency (A/D converter latency + DSP processing)
- SRC creates additional latency (0,5 – 2ms)

Power consumption of digital microphones

- AES42 Standard: < 250 mA at 10 V = 2.5 W
- in practice: 1 – 2 W for digital microphones (< 0.2 W for analog microphones)
    - SCHOEPS SuperCMIT: 170 mA
    - Sennheiser MZD 8000: 160 mA
    - Neumann KMD: 150 mA
    - SCHOEPS CMD 2: 100 mA

Cables:

- Digital signals require 110Ω cables, cable length can be max. 300m

- How do I deal with the latency issue?
- Is power consumption an issue?
- What happens on analog cables?

Sample Rate Converter (SRC):

- a SRC is needed whenever two digital signals are not sharing the same clock
- a digital microphone needs no SRC when:
  - it synchronizes to a master clock
  - it is the clock master
- Latency: 0.5 – 2 ms, depending on the sample rate (~100 Samples)
- Audio quality: modern SRC achieve near-24bit-quality (no modulation-dependent distortion of any kind, 140dB dynamics)

➢ Does an SRC impair the signal?

4./5. Practical issues with digital microphones

- Operational reliability, Differences between analog and digital microphones:
  - EMC
  - Cables, Phantom power
  - Software, DSP
  - other side effects, e.g. Humidity

- Practical experiences with digital microphones

- ➢ Do digital microphones improve the operational reliability in practice?
- ➢ Is it more complicated to work with digital microphones than with analog?

- ➢ Do we know practical experiences with digital microphones in the field?
- ➢ What are the main applications for digital microphones today and in the future?

6. Additional benefit of digital microphones

- Dynamics (?)
- Ease-of-use (?)
- Features
- Costs (?)
- ?

➢ What are the essential additional benefits of digital microphones compared to analog?

7. Future of digital microphones

- AES 42?
- Networked microphone?
- other features?
- ?

- Will the AES42 standard be successful?
- Will there be a networked microphone?
- Will there (only) be digital microphones in the future?

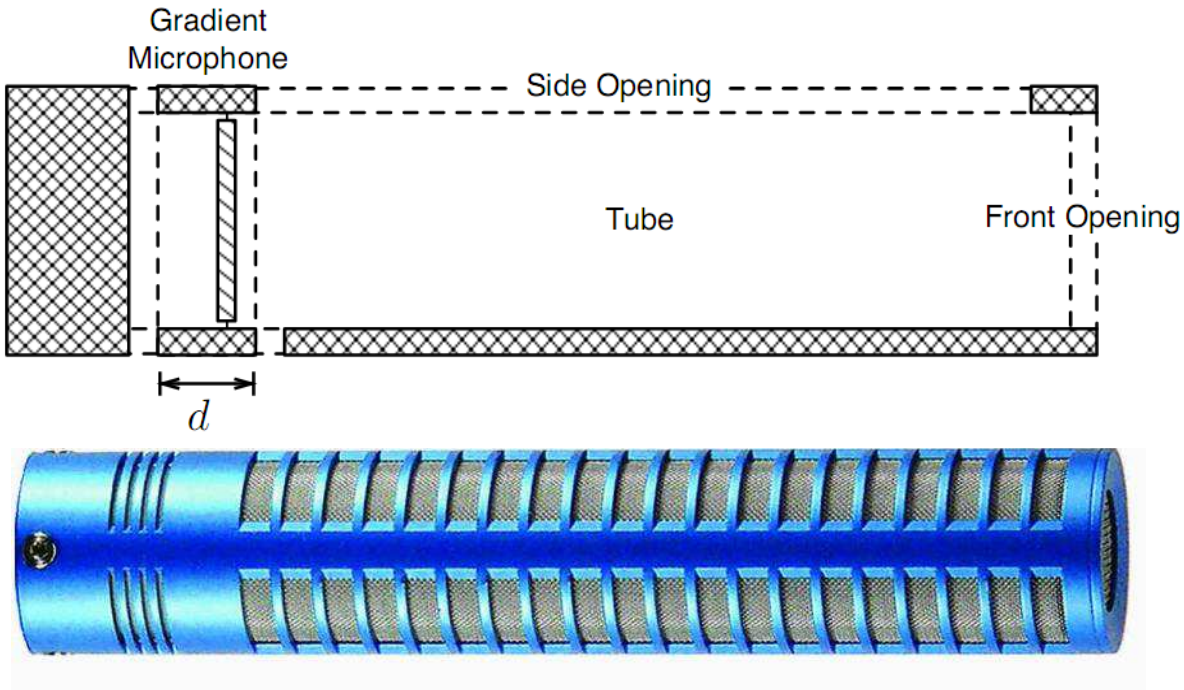
Practical application of the SuperCMIT

Das SuperCMIT in der praktischen Anwendung

- SuperCMIT: technology, hardware
- SuperCMIT: Properties
  - Frequency responses, Polar patterns
  - Diffuse field response
- SuperCMIT: Application and sound samples

Existing technology of directive microphones

- Existing technology of directional microphones:
  - first-order pressure-gradient microphones
  - higher-order gradient microphones
  - interference tube microphones (“shotgun microphones”)
  - Parabolic mirrors

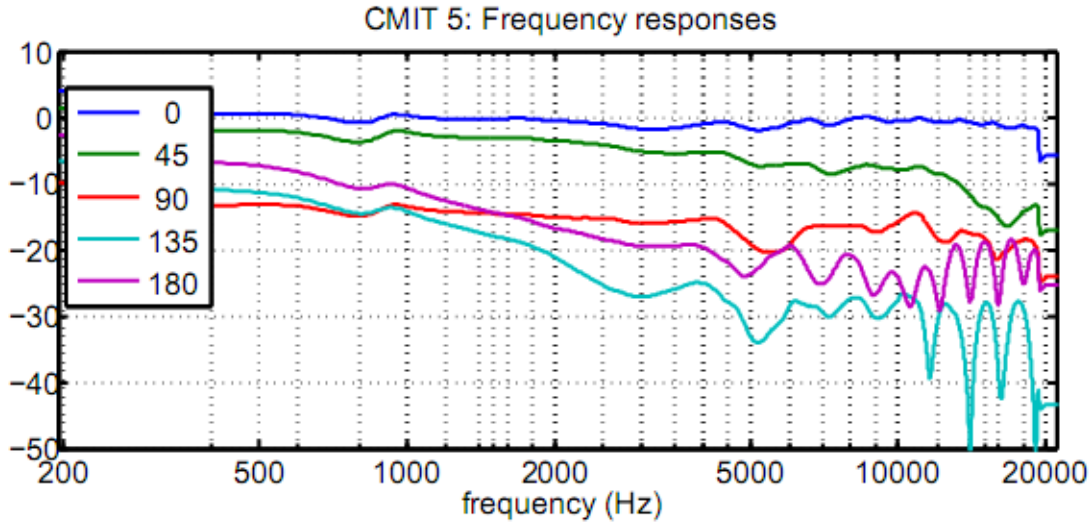


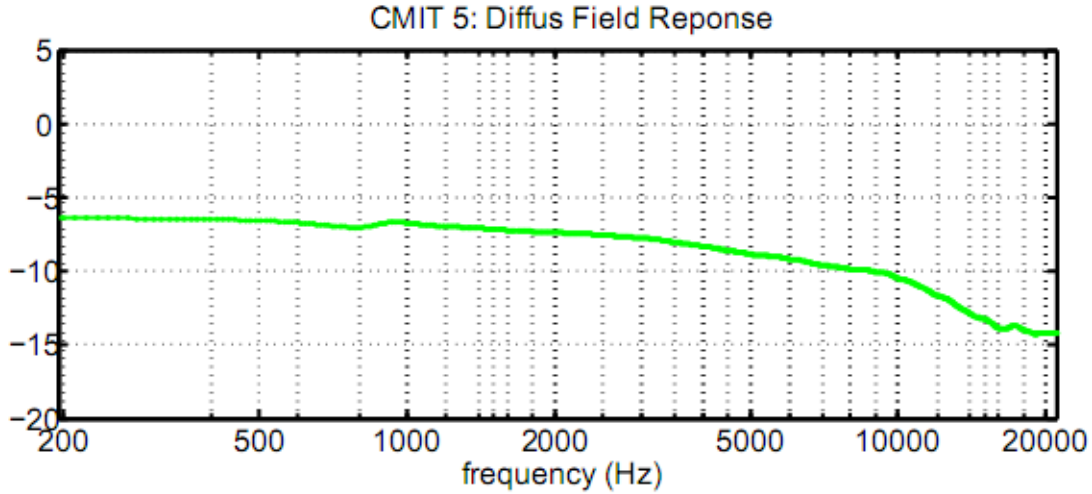
Shotgun microphone

CMIT 5U

Interference tube (“shotgun microphone”, “Richtrohr”)

- Weakness of the conventional shotgun microphone:





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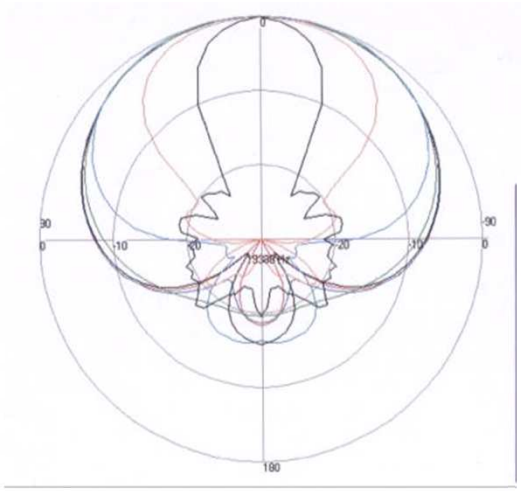
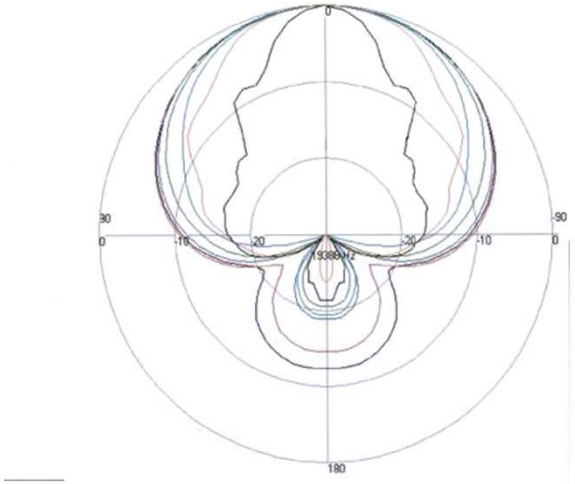


Sennheiser MKH 416



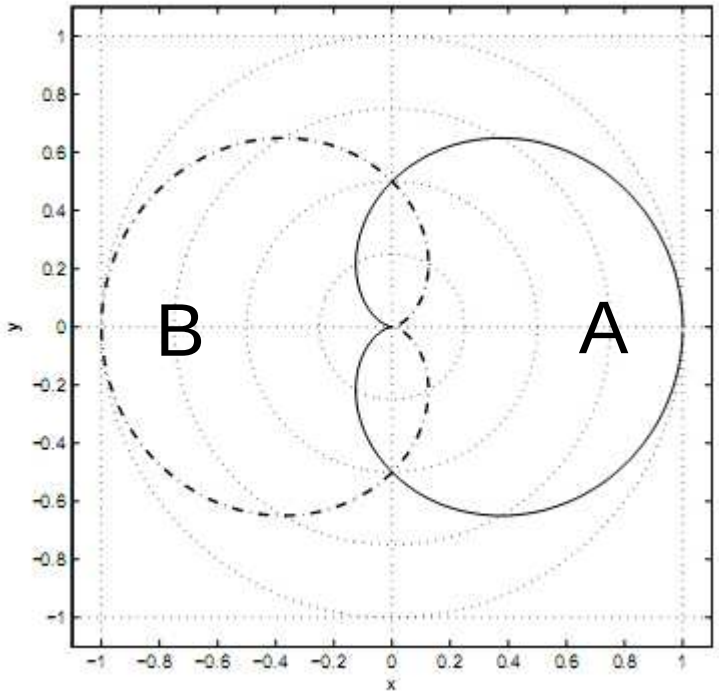
SCHOEPS CMIT 5

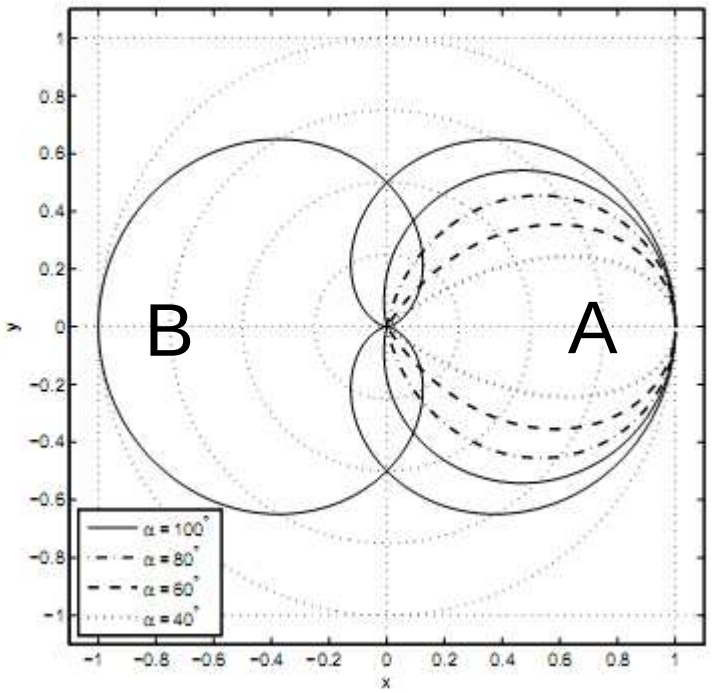
- “Super”- shotgun SCHOEPS SuperCMIT
  - 2 membranes
  - digital signal processor with beamforming algorithm
  - digital output (AES42/Mode-1 = *AES3 + 10V*)
  - 2 output channels:
    - ch1: SuperCMIT
      - Preset 1 (normal DSP mode)
      - Preset 2 (strong, take care!)
    - ch2: conventional shotgun signal

- Combining shotgun and beamforming approach:

- A 2nd capsule (cardioid) is placed behind the shotgun capsule
- These two capsules form a “beamforming” array
- Beamforming increases the *directivity* and suppresses diffuse *sound*
- Above 5 kHz only the shotgun signal is used

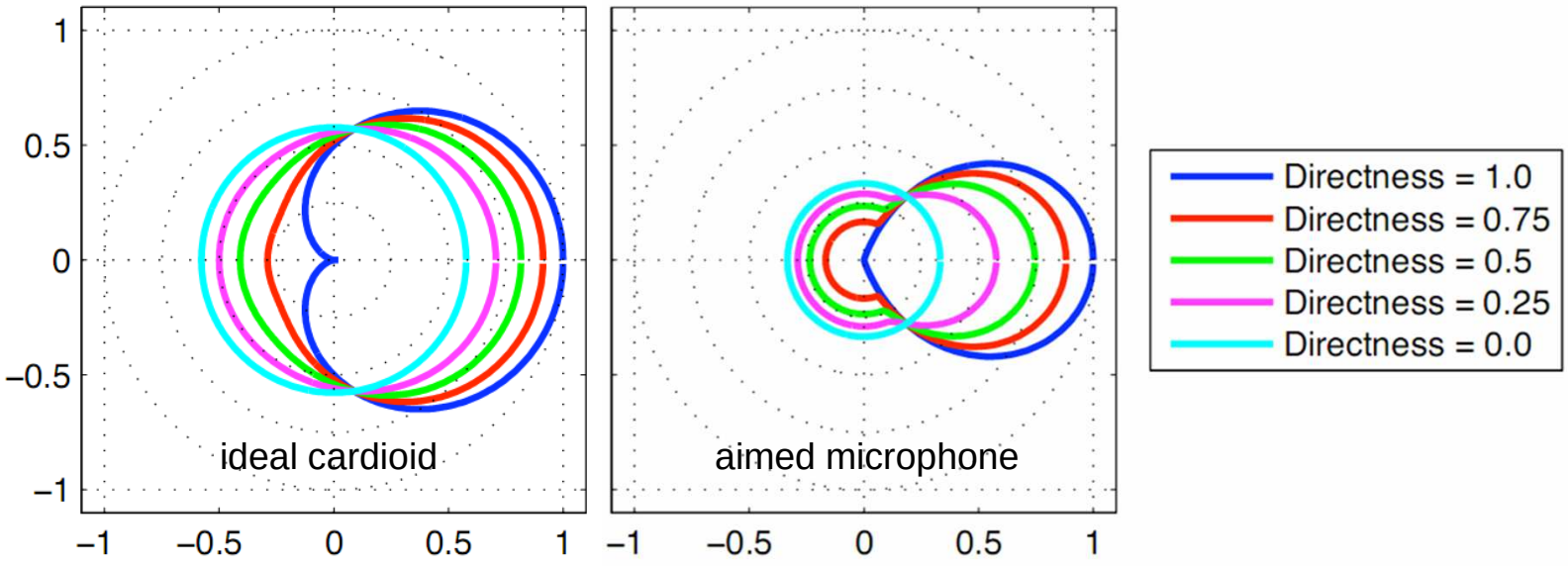
- Utilize Beamforming
  - using two cardioids in a back-to-back configuration
  - A can be predicted with/from B
  - the predicted signal can be subtracted from A
  - Subtraction is limited to a maximum to decrease effect



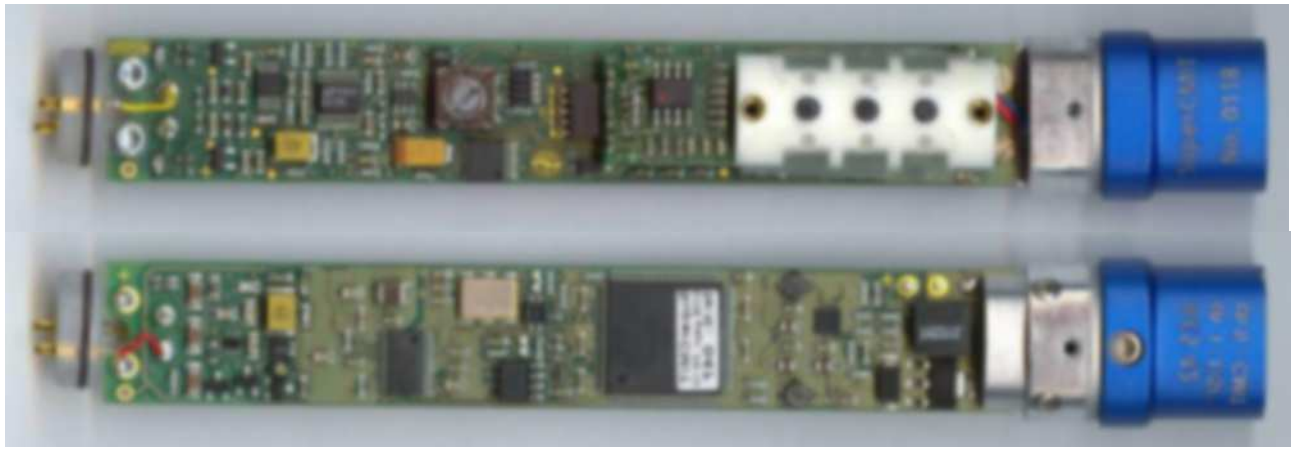


- Adjusting the diffuse field level
  - Time-Frequency processing enables to find coherent/incoherent signals
  - The diffuse field level can be tuned according to the resulting beam

Directional response at different "*Directness*" levels:



- SuperCMIT: Hardware design

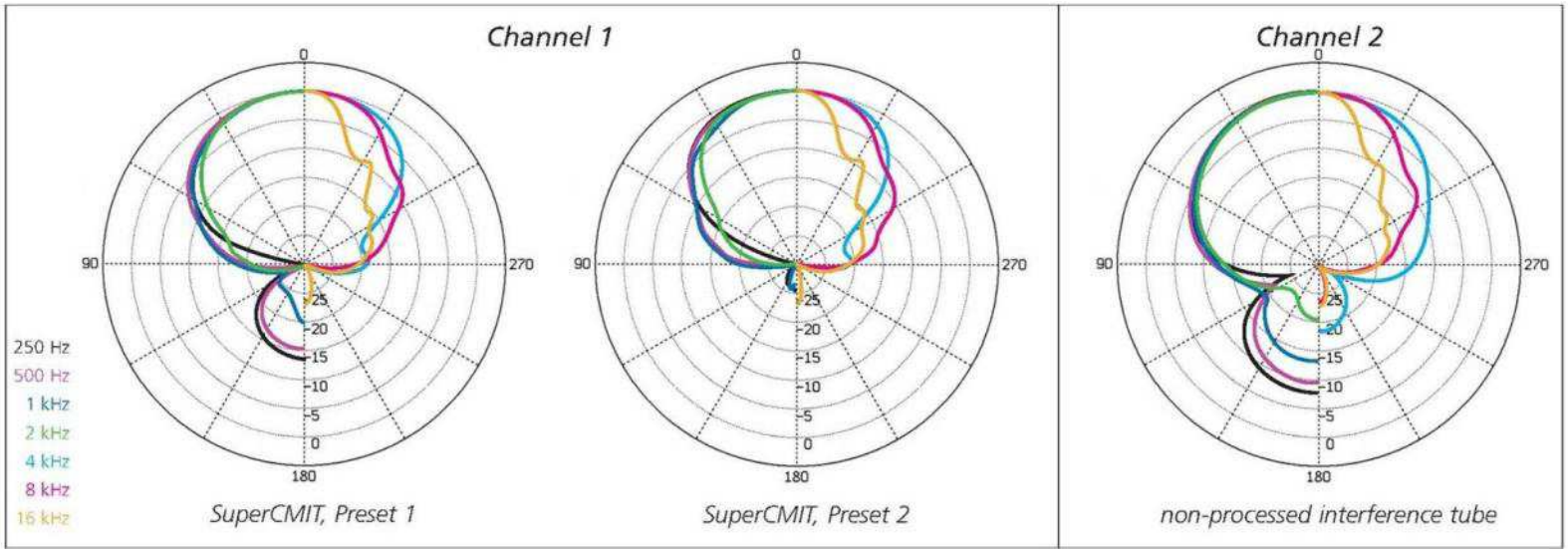


front view

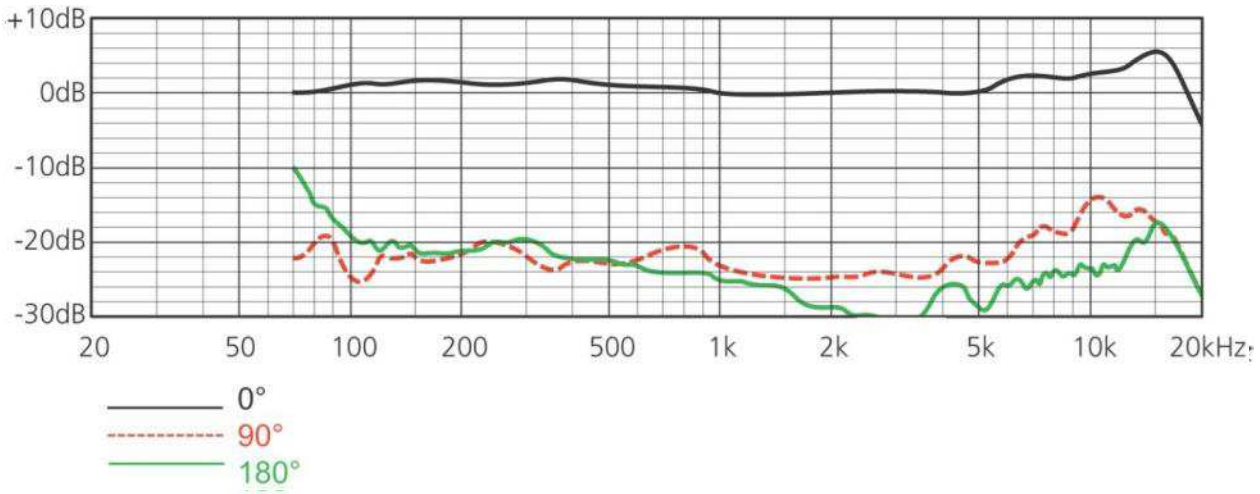
back view

- Weight: 112 grams (4 ounces)
- Length: 280 mm

- SuperCMIT: Polar diagrams



- SuperCMIT: Frequency responses



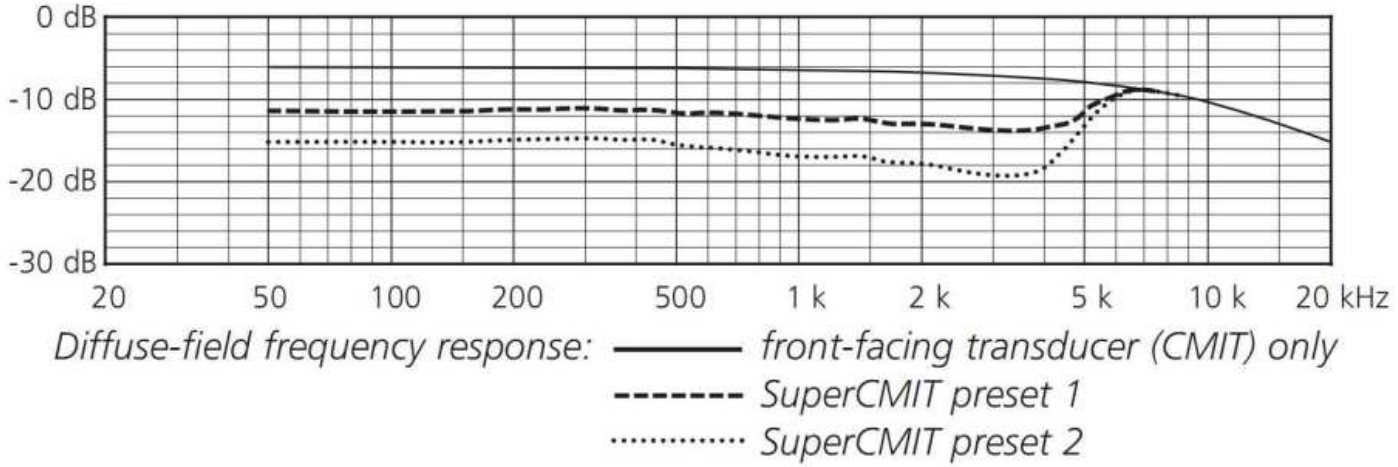
→ SuperCMIT ch2 (unprocessed)

→ SuperCMIT, ch1, Preset 1

→ SuperCMIT, ch1, Preset 2

- SuperCMIT: Diffuse Field Frequency response

Diffuse Field frequency reponse:



- Diffuse Field Frequency responses:

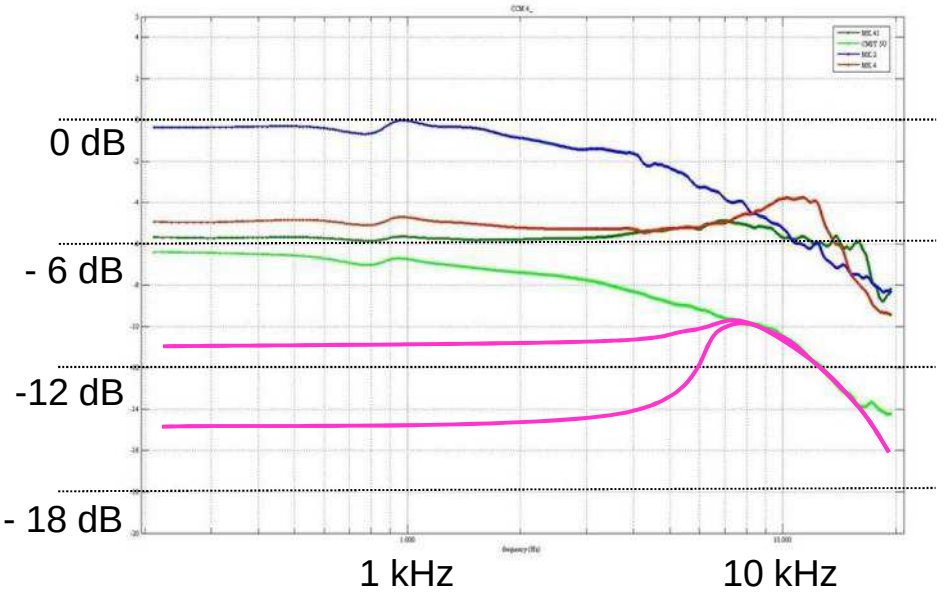
Omni MK 2

Cardioid MK 4

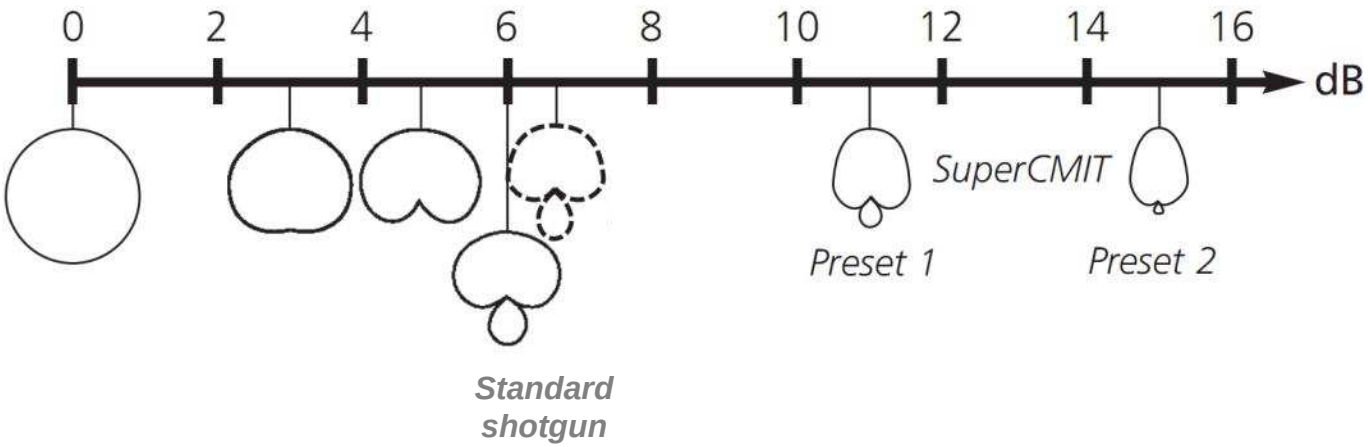
Supercardioid MK 41

Shotgun CMIT 5

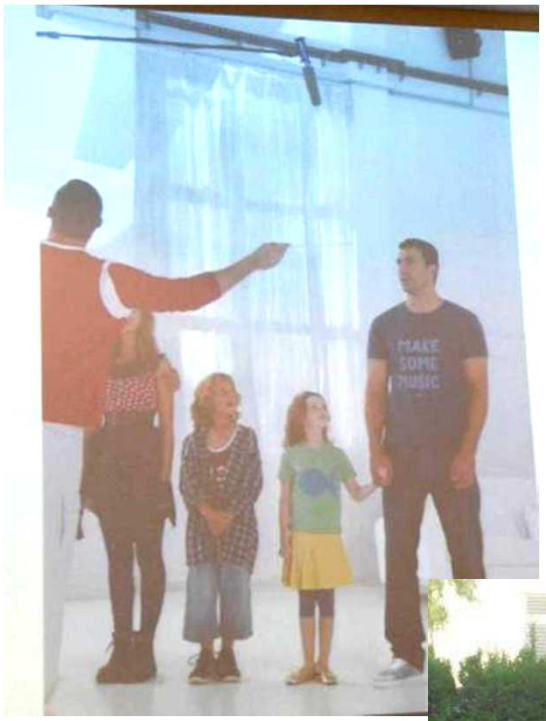
SuperShotgun SuperCMIT



- SuperCMIT: Directivity index (= level of the diffuse sound at low frequencies)



(some…) Applications



- Location sound
- Sports
- Theatre, Opera
- on a lectern
- in churches

- 3 Pushbuttons on the microphone:
  - High-frequency boost (+5 dB at 10 kHz)
  - Steep Low-Cut (18dB/Oct)
  - Preset button:
    - Preset 1: normal
    - Preset 2: strong; recommended only for special applications

- Available accessories
  - Foam windscreen W 170
  - WSR SuperCMIT: Basket Windscreen with suspension (Rycote Kit 295)
  - WSC Piano Pia-1: Basket Windscreen with fur
  - Rycote Softie 18cm
  - Cinela OSIX CMIT

Interfacing

- Output format of the SuperCMIT: AES42, Mode 1
  = AES3 + 10V digital phantom power.

- You have different options of interfacing the SuperCMIT:
  - **Adapters** (SCHOEPS Mini-DA42 or PSD 2U):
    10V powering /and analog output
    (comes with the microphone)

  - **Portable recorders** (SoundDevices 788T, AETA 4Minx, Zaxcom Nomad)
  - **Consoles** and **interfaces** (STAGETEC XER-M, RME DMC 842, Lake People DAC 462, etc.)
  - **PC Sound cards** (Digigram, Marian)
  - **Wireless** (Zaxcom)
  - **Complete list** of interfacing options for the SuperCMIT:
    http://digital.schoeps.de/documents/2012-03_SuperCMIT_Compatibility.pdf

SuperCMIT: more information

- SCHOEPS website (www.schoeps.de; www.supercmit.com)
  - Infos on interfacing, technical data
- Press reviews: Resolution 06/2010, Audiomedia 07/2010, etc.
- Listen:
  - Live demo
  - Audio samples on www.schoeps.de
- Just try it
  - us@decibel.ch
  - wittek@schoeps.de

Many thanks for your attention!